FACTS

Ministry of the Environment
Ontario

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Minister

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ABOUT POLYCHLORINATED BIPHENYLS (PCBs) (Revised February 1984)

What are PCBs?

Polychlorinated biphenyls are a class of man-made organic chemicals produced by the direct combination of chlorine and biphenyl, a derivative of benzene. There are 209 theoretical possible combinations of chlorine and biphenyl but commercial preparations contained only up to 80 different PCB compounds.

PCBs are clear, colourless viscous liquids which have the appearance of mineral oil. They are insoluble in water and in fact are denser than water such that they sink to the bottom when added to water. PCBs are stable, non-flammable and resistant to chemical attack. However, these very properties, which first prompted their commercial production and industrial exploitation in 1929, have contributed to their widespread distribution and stability in the environment.

How are they used?

PCB uses can be classified as dispersive or closed-system. The dispersive uses were as extenders and plasticizers in a variety of sealants, caulkings and coatings, as additives in carbon papers and printing inks and as automotive and industrial hydraulic and heat exchange fluids. As these materials were discarded, the PCB component became dispersed in the environment. Closed-system usage included electrical insulating fluid applications in commercial and industrial electrical transformers and capacitors and in some classes of closed industrial heat transfer systems.

No PCBs have been sold in North America for dispersive applications since 1972, as a result of a voluntary ban on such sales by the sole North American producer, Monsanto Chemical Corporation. (There were never any production facilities in Canada.)

Since that time, regulations under the Canada Environmental Contaminants Act, and corresponding legislation in the United States, have effectively banned all uses of PCB except in existing electrical equipment operating prior to the date of the ban (in Canada, July 1980).

Regulation 11/82 of the Environmental Protection Act of Ontario provides for the on-site interim storage of PCB wastes by owners of PCB equipment provided that such storage is authorized by the Ministry. Furthermore, all movements of wastes to and from storage sites on public roads must be via carriers licenced under authority of Regulation 313 of the Environmental Protection Act.

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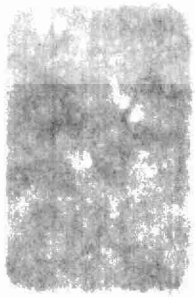

The production of PCBs was banned by the Toxic Substances Control Act in the United States in 1976. The estimated North American production since 1929 is about 700,000 metric tons, of which approximately 50 per cent remains in existing electrical equipment. About 9,000 metric tons are still in use in electrical equipment in Ontario.

Are PCBs dangerous?

For many years, isolated reports in industrial medical literature concerning the toxic effects of PCBs attracted little general interest. In terms of acute toxicity, that is, the level of exposure necessary to cause an acute and immediately harmful effect, PCBs are relatively low on the scale and significantly less toxic than many other more common industrial and consumer chemical products. Direct contact with high concentrations of pure PCB may produce health effects ranging from mild skin rash to severe toxicity depending on the degree of exposure and, hence, the quantity ingested.

Public awareness has been aroused by incidents such as the poisoning of about 1,000 people in Yusho, Japan, in 1968 from the gross contamination of rice oil by PCB heat exchange fluid. This led to the voluntary restriction on sales by Monsanto in 1972 to closed-system electrical equipment manufacturers. There is now evidence to suggest that the effects of the poisoning may have been related not only to PCBs but also to more toxic contaminants contained in the PCB heat exchange fluid.

As equipment became available in the 1960s to enable the measurement of trace levels of PCB in the environment, the significance of these environmental levels began to be assessed by numerous research workers conducting animal feeding studies. The results of these studies indicated the potential for PCB to be a cancer-causing substance and confirmed the potential to interfere with reproductive processes.

There is little scientific evidence to indicate that any of the chronic effects shown in animal studies are exhibited in humans either exposed to PCB in the workplace or exposed to the current levels in the environment. Taking this into consideration, it is a simple matter of prudence for environmental and health authorities to take measures to restrict and prevent human exposure to PCBs. It remains a matter of public concern. It is not, however, a matter which warrants the degree of public alarm so often associated with PCB spills or other evidence of release of PCBs into the environment.

The real environmental concern is that PCBs are very stable in the environment and are absorbed and accumulated by many life forms. PCBs become more concentrated as they pass up food chains from one life form to another (bio-magnified). They are present in some foodstuffs, particularly those derived from fish and animals that are at the end of their respective food chains. As well, PCBs are present in trace levels in ambient air and in natural waters and sediments.

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The principal health concern centres on this passage of PCBs up food chains, such that they gradually become concentrated in the fatty tissue of fish, birds and animals which may form part of the human diet.

Levels of PCBs in edible fish are of immediate concern, particularly from the standpoint of consumption of fish caught by sports fishermen. Commercial fish catches in the Great Lakes cannot exceed the federal guideline of two parts per million maximum PCBs that thas been established by Health and Welfare Canada.

Sports fish, particularly salmonid species that were introduced into the Great Lakes by various state and provincial agencies, show evidence of high levels of contamination. To meet this concern, Ontario publishes information on testing of fish for contamination and issues advisories on the consumption of fish which have accumulated traces of PCBs or other contaminants such as mercury.

PCBs are widely distributed in the environment. Airborne transport is evident from the fact that scientific data gathered from around the world show the presence of PCBs in areas remote from industrial influence such as Bermuda, Hawaii and the polar ice cap. Detectable levels are found in the vicinity of most urban and industrial centres in North America.

The prevalance of this contaminant strengthens Environment Ontario's opinion that PCB-contaminated material ultimately must be destroyed rather than running the risk that it enters the environment, and hence the food chain.

In order to address the issue of environmental contamination, and subsequent bio-magnification up food chains, it is necessary to restrict input of PCBs to the environment. In North America this has been implemented by restriction on the manufacture, sale, distribution and usage of products containing PCBs; by restriction on the storage, handling and disposal of PCB wastes and by the development and application of the most advanced technologies available for waste destruction and disposal.

Destruction of PCBs

High-temperature incineration has been identified by all regulatory authorities in North America as the safest and most effective method of PCB destruction. This may be achieved in specially designed high temperature incinerators or in suitably modified industrial furnaces. High temperature incineration can achieve PCB destruction efficiencies in the order of 99.9999 per cent and experimental burning of PCB mixtures at the St. Lawrence Cement plant in Mississauga reflected a destruction efficiency of at least 99.986 per cent, while realizing other benefits to the cement company such as fuel savings and the production of low alkali cement. This technology has been successfully applied in Europe.

However, because of public objections no full-scale PCB destruction facility has been established anywhere in Canada. Numerous private and public sector proposals for PCB destruction have been frustrated by public opposition. Consequently, efforts have been directed towards the development of more advanced technologies for PCB destruction (with a view to improving public acceptance). In addition, all movements of PCB wastes to and from storage sites must be via carriers licenced under authority of Regulation 313 of the Environmental Protection Act.

Since 1979, the Ministry of the Environment has provided about $2 million for research and development into methods of PCB destruction and disposal. These have included incineration and plasma arc technologies. (A plasma arc is a high temperature gas induced by an electric arc. Through its use, extremely high temperatures can be achieved in a small container sufficient to cause molecular disintegration of PCB.)

Other technologies that have been considered include combustion-induced plasmas, microwave plasma-induced oxidation, wet-air oxidation, chemical reduction with metallic sodium derivatives, biological degradation and diesel engine combustion.

An estimated six million litres (1.25 million gallons) of PCB liquids are in service in Ontario. In addition, about 100,000 gallons of wastes are in storage awaiting disposal. This will gradually increase as PCB-filled electrical equipment is replaced or taken out of service.

The availability of PCB destruction technology is not, however, the issue in the resolution of the disposal problem. It is the public's concern about the hazard associated with the siting of destruction facilities which has prevented the destruction of PCB by any means.

As a society, we must begin to recognize that enormous emotional and financial resources have been directed towards attempts to resolve the PCB disposal problem with no tangible result, while other, more pressing waste management and environmental issues may have received correspondingly less attention.

Environment Ontario is moving towards the development of regulatory proposals which will facilitate the establishment of mobile PCB destruction facilities. At the same time, the long term hazardous waste management and disposal requirements will be addressed by existing private sector facilities and new facilities to be established by the Ontario Waste Management Corporation.

Environment Ontario needs the support and encouragement of the citizens of Ontario to ensure that these efforts will achieve the establishment of safe, effective PCB destruction facilities in Ontario.